

UNITED STATES DEPARTMENT OF COMMERCE  
PATENT AND TRADEMARK OFFICE

INVENTION : VIRTUAL ELECTRONIC BACK-UP ALIGNMENT APPARATUS  
INVENTOR : JOHNSON, KEITH R.

1 I. FIELD OF THE INVENTION

2 The present invention relates to an apparatus for aligning a vehicle hitch to the tow  
3 hitch of a trailer and, more particularly, to an electronic back-up alignment apparatus that  
4 utilizes the combination of a light emitting source and reflective means for producing a  
5 directional guideline light beam for aligning the vehicle to the trailer.

6 II. DESCRIPTION OF THE PRIOR ART

7 For every vehicle that tows a trailer, the most difficult part is connecting the vehicle  
8 hitch to the tow hitch of a trailer. The vehicle hitch is typically installed to the vehicle frame  
9 centrally located at the rear of the vehicle and adjacent to the rear bumper. The tow hitch of  
10 the trailer is centrally located in the front of the trailer and in the approximate horizontal plane  
11 above the ground as the vehicle hitch. The reason the connection of the vehicle to the trailer  
12 presents such difficulty is because neither the vehicle hitch nor the trailer tow hitch are visible  
13 to the driver of the vehicle when attempting to align the vehicle for connection to the trailer.  
14 As a result, the driver's blind alignment of these two hitches for connection to one another  
15 imposes an imprecise, arduous task.

16 In the past, there have been a number of devices developed to solve this problem.  
17 These include U.S. Patent 6,139,041 to Murphy entitled "Trailer Hitching Alignment Aid";  
18 U.S. Patent 5,108,123 to Rubenzik entitled "Vehicle Docking Device Using Sensor Matrix";  
19 U.S. Patent 5,513,870 to Hickman entitled "Guidance System For Use In Docking A

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1 Movable Vehicle With A Stationary Target”; U.S. Patent 6,100,795 to Otterbacher entitled  
2 “Trailer Hitch Alignment System”; U.S. Patent 4,186,939 to Woods entitled “Electro-  
3 Mechanical Docking Apparatus and Method”; U.S. Patent 4,432,563 to Pitcher entitled  
4 “Hitching Guidance Device”; U.S. Patent 4,938,495 to Beasley entitled “Trailer Hitch  
5 Positioning Apparatus”; U.S. Patent 5,650,764 to McCullough entitled “Trailer Alignment  
6 Device With Visual Display”. However, none of these devices disclose, teach or use a  
7 transportable apparatus, attachable to a vehicle, that utilizes a light source coacting with a  
8 gravity leveling reflective device for providing a directional beam which is visible by the driver  
9 for aligning the hitch of a vehicle to the tow hitch of a trailer.

10 Thus, there is a need and there has never been disclosed Applicant’s electronic back-  
11 up alignment apparatus.

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**III. OBJECTS OF THE INVENTION**

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It is the primary object of the present invention to provide a means for a driver to align the hitch of a vehicle to the tow hitch of a trailer. A related object of the present invention is to provide a light source and optional reflective surface for providing a directional light beam and virtual tow point to guide the proper alignment of the vehicle and trailer.

Another related object of the invention is to provide an apparatus and a directional light beam or virtual tow point that is visible to the driver of the vehicle.

Another object of the present invention is to provide an apparatus that can be used by one person for properly aligning the vehicle with the trailer. A related object of the invention is to permit the apparatus to be used by the person who is operating the vehicle and backing it toward the trailer.

Another object of the invention is to provide an apparatus that reduces the time and energy to align the vehicle hitch with the trailer tow hitch. A related object of the invention is to reduce the accidents and injuries caused when vehicle hitches are not properly aligned with the tow hitch of the trailers.

Still another object of the invention is to provide a device that is safe and easy to use.

Other objects of the present invention will become more apparent to persons having ordinary skill in the art to which the present invention pertains from the following description taken in conjunction with the accompanying drawings.

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**IV. SUMMARY OF THE INVENTION**

1  
2           The present invention is an electronic back-up alignment apparatus that consists of a  
3   housing that provides a cylindrical column for fixedly securing a light emitting source parallel  
4   to a vehicle. The cylindrical column has a slip ring to engage a light source actuator on the  
5   light emitting source for activating the light emitting source and generating a light beam. A  
6   free rotating mirror assembly receives the light beam from the light emitting source and  
7   reflects the light beam into a directional guideline towards the trailer and forms a virtual tow  
8   hitch point for enabling the user to obtain the perfect alignment of the vehicle hitch to the  
9   trailer tow hitch. The free rotating mirror assembly comprises a gravity orientation balancer,  
10   a mirror, and a pair of bearing wheels encapsulated within a hollow, transparent tube secured  
11   to the housing.

**V. BRIEF DESCRIPTION OF THE DRAWINGS**

12  
13           The Description of the Preferred Embodiment will be better understood with reference  
14   to the following figures:

15           Figure 1 is a front perspective view illustrating the electronic back-up alignment  
16   apparatus being used, in this example, for aligning a vehicle hitch to the tow hitch of a trailer.

17           Figure 2 is a side perspective view of an alternate embodiment of the electronic back-  
18   up alignment apparatus in which multiple directional light beams are used for back-up  
19   alignment of a vehicle hitch to the tow hitch of a boat.

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1           Figure 3 is a side perspective view of the alternate embodiment of Figure 2 depicting  
2   the directional guidelines and off-center virtual tow hitch points when the vehicle hitch is not  
3   in perfect alignment with the hitch of the boat.

4           Figure 4 is a front perspective view depicting the assembled electronic back-up  
5   alignment apparatus.

6           Figure 5 is an exploded view of Figure 4, with portions removed, of the free rotating  
7   mirror assembly.

8           Figure 6 is a perspective view of the assembled free rotating mirror assembly.

9           Figure 7 is an electrical schematic diagram of the invention further comprising a sonar  
10   or anti-collision system and how it can be used to activate the electronic back-up alignment  
11   apparatus.

12           Figure 8 is an electrical schematic diagram of the invention further comprising an  
13   ultrasonic distance measurement device for providing the driver with the distance between the  
14   vehicle hitch and the trailer tow hitch.

15           Figure 9 is an electronic diagram depicting the light emitting diode indicators of  
16   distance measurement which is powered by a local power source.

17           Figure 10 is one possible layout of an electronic circuit board of the ultrasonic  
18   distance measurement device for activation of the light emitting diode distance indicators.

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1        **VI. DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT**

2            Turning first to Figure 1, there is illustrated an electronic back-up alignment apparatus  
3        20. In the preferred embodiment, the electronic back-up alignment apparatus 20 is positioned  
4        on a tailgate ledge 22 of a truck bed 24 of a vehicle (not illustrated). Alternatively, the  
5        electronic back-up alignment apparatus 20 may be positioned on the vertical portion of the  
6        tailgate. The truck bed 24 provides a hitch 26 and a hitch ball 28. The truck bed 24 of the  
7        vehicle is shown backing up in the direction towards a trailer 30. The trailer 30 provides a tow  
8        hitch 32 for receiving the hitch ball 28 of the hitch 26 of the vehicle. The tow hitch 32 is  
9        located in the front of and at the base of the trailer 30. As situated, the tow hitch 32 is  
10       positioned in the approximate horizontal plane, in relation to the ground, to correspondingly  
11       receive the hitch ball 28 when the hitch 26 and the tow hitch 32 are properly aligned for  
12       assembly. Upon connecting the hitch 26 with the tow hitch 32, the vehicle is ready to pull the  
13       trailer 30. Applicant's electronic back-up alignment apparatus 20 is a directional alignment  
14       device designed to enable a user to properly align the hitch 26 of the vehicle with the tow  
15       hitch 32 of the trailer 30 and, thereby, facilitate connecting the hitch 26 and tow hitch 32 for  
16       towing the trailer 30.

17           The electronic back-up alignment apparatus 20 is preferably for use by the driver of  
18       the vehicle and may be used in connection with any type vehicle including but not limited to  
19       a truck, van, car, recreational vehicle, etc..., that contains any type of hitch 26 which connects  
20       to a tow hitch 32 on any type of trailer, towing device, or otherwise.

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1           In use, the electronic back-up alignment apparatus 20 generates a reflected light beam  
2   34. The light beam 34 originates from the electronic back-up alignment apparatus 20 and  
3   leaves the truck bed 24 from a vertical centerline plane 36 which passes through the hitch 26.  
4   The light beam 34 generates a directional guideline 44 that extends from the truck bed 24 to  
5   the trailer 30. When the light beam 34 reaches the trailer 30, the light beam 34 creates a  
6   virtual tow point 38 on the trailer 30. In the preferred embodiment, the virtual tow point 38  
7   on the trailer 30 is in a vertical centerline plane 40 that passes through the tow hitch 32. In  
8   this position, the hitch ball 28 of the hitch 26 of the vehicle is in “perfect alignment” with the  
9   tow hitch 32 of the trailer 30. This is represented by perfect line 46. The directional guideline  
10   44 generated by the light beam 34 and the virtual tow point 38 are visual to the human eye.  
11   The light beam 34 travels a closing distance 42 which represents the distance between the  
12   truck bed 24 of the vehicle and the trailer 30. As the vehicle backs up and moves in the  
13   direction towards the trailer 30, the closing distance 42 will decrease until the hitch ball 28  
14   of the hitch 26 is in position to be received by the tow hitch 32 of the trailer 30.

15           If the virtual tow point 38 is not in the vertical centerline plane 40, then the vehicle  
16   is moving in a direction towards the trailer 30 in which the hitch 26 is not properly aligned  
17   with the tow hitch 32. If the vehicle is moving toward the right side of the trailer 30 and tow  
18   hitch 32 (as viewed from the driver of the vehicle), the directional guideline 44 of the light  
19   beam 34 will generate path A and display an off-center virtual tow point 48. If the vehicle is  
20   moving toward the left side of the trailer 30 and tow hitch 32 (as viewed from the driver of

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1 the vehicle), the directional guideline 44 of the light beam 34 will generate path B and display  
2 an off-center virtual tow point 50. Upon seeing path A or B of the directional guideline 44  
3 and the resulting off-center virtual tow points 48 or 50, the driver will realize that the vehicle  
4 is not approaching the trailer 30 in perfect alignment between the hitch 26 and the tow hitch  
5 32. As a result, the hitch 26 is misaligned from the tow hitch 32 an off-center distance 52.

6 In the path A example, to reposition the vehicle to obtain the perfect alignment, the  
7 driver must turn the vehicle and the hitch 26 left such that path A moves in the direction  
8 toward the directional guideline 44 and the perfect line 46 until the off-center distance 52 is  
9 reduced to zero. Upon reaching an off-center distance 52 of zero, path A overlies directional  
10 guideline 44 and the off-center virtual tow point 48 becomes the virtual tow point 38. In the  
11 path B example, the driver turns the vehicle in the opposite direction or to the right to obtain  
12 the same result. Thus, in each instance, the "perfect alignment" between the vehicle and the  
13 trailer is again realized. The driver continues to adjust the vehicle to maintain the perfect  
14 alignment until the hitch 26 is correspondingly aligned for connection to the tow hitch 32.

15 Alternatively, it is contemplated that off-center virtual tow points 48 or 50 may  
16 engage a reflective material 49 provided on the trailer 30 to further assist the user or as an  
17 indication to the user that the vehicle is misaligned with the trailer 30. The reflective material  
18 49 may be any color or multitude of colors, as desired. The reflective material 49 may be  
19 affixed to the trailer 30 by any means including but not limited to magnets, adhesive tape,  
20 glue, etc...



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1           Turning to Figure 2, an alternate embodiment of the electronic back-up alignment  
2   apparatus 20 is illustrated. The electronic back-up alignment apparatus 20 is alternately  
3   located along the inside ledge of the back window of the vehicle referred to as alternate  
4   position 54. The alternate position 54, as in the original embodiment, generates a light beam  
5   34 along directional guideline 44 in the same horizontal plane as the perfect line 46 thereby  
6   continuing to produce the “perfect alignment.” Also, in this embodiment, the vehicle is being  
7   aligned with a trailer (not illustrated) that contains a tow hitch 32 for pulling a boat 56. The  
8   virtual tow point 38 created by the light beam 34 engages the boat 56 along the boat’s  
9   centerline 58. Like in the original embodiment, the boat’s centerline 58 is positioned in the  
10   same vertical centerline plane 40 as the tow hitch 32.

11           As the boat 56 has a receding and arcing front surface 60 which is not flat or  
12   perpendicular to the line of sight of the driver of the vehicle as the trailer 30 in the original  
13   embodiment, this alternate embodiment may further include multiple directional light beams  
14   for aligning the vehicle to the tow hitch 32 for the boat 56. The electronic back-up alignment  
15   apparatus 20 is located in the alternate position 54 and has additional alignment apparatus 20  
16   located in the rear taillight assemblies of the vehicle at positions 62 and 64. At positions 62  
17   and 64, the electronic back-up alignment apparatus 20 will generate light beams 66 and 68,  
18   respectively. The generated light beams 66 and 68 define width 70 of the truck bed 24. As  
19   a result, with the electronic back-up alignment apparatus 20 located at alternate position 54,  
20   position 62, and position 64, the driver is provided with a directional guideline 72 defining

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1 the left side of the truck bed 24, the directional guideline 44 defining the center of the truck  
2 bed 24, and a directional guideline 74 defining the right side of the truck bed 24. When each  
3 of the guidelines are in the correct position as illustrated, the hitch 28 of the hitch 26 of the  
4 vehicle is in "perfect alignment" with the tow hitch 32 of the trailer for the boat 56.

5 If the virtual tow point 38 is not in the vertical centerline plane 40 and parallel to the  
6 perfect line 46, then the vehicle is again moving in a direction towards the boat 56 in which  
7 the hitch 26 is not properly aligned with the tow hitch 32 of the trailer. When this occurs, if  
8 the vehicle is moving toward the right side of the tow hitch 32 or boat centerline 58 (as  
9 viewed from the driver of the vehicle), the directional guidelines 72, 44, and 74 will produce  
10 paths C, D, and E, respectively, and display off-center virtual tow points 76, 78, and 80, as  
11 illustrated in Figure 3. Upon seeing any of the paths C, D, or E of the directional guidelines  
12 72, 44, or 74, and the resulting off-center virtual tow points 76 (this point is not visible as it  
13 misses the boat and does not strike anything), 78, or 80, the driver will realize that the vehicle  
14 is not approaching the boat 56 in perfect alignment between the hitch 26 and the tow hitch  
15 32. As a result, the driver must then reposition the vehicle to the perfect alignment as  
16 previously discussed.

17 Turning to Figure 4, the components of the electronic back-up alignment apparatus  
18 20 are more clearly shown. The electronic back-up alignment apparatus 20 comprises a  
19 housing 82, a light emitting source 90, a light source cover 84, and a free rotating mirror  
20 assembly 86.

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1           The housing 82 provides a cylindrical column 89 to receive the light emitting source  
2   90. The cylindrical column 89 secures the light emitting source 90 by set screws (not  
3   illustrated). Alternatively, it is contemplated that a person skilled in the art may utilize any  
4   known means or method for securing the light emitting source 90 within the cylindrical  
5   column 89. The cylindrical column 89 is encapsulated by a cylindrical bore 88 that frictionally  
6   receives the light source cover 84 which also provides a cover for the light emitting source  
7   90.

8           In the preferred embodiment, the light emitting source 90 is a standard, off the shelf  
9   laser pointer, Model LS-11, manufactured by Limate Corporation located in Taipei, Taiwan.  
10   The light emitting source 90 has an elongated body 92 with a light source actuator 94 to  
11   active the light beam 34 and a lens opening 96 to release the light beam 34 when activated.  
12   As the light emitting source 90 is a standard off the shelf device that may be used as a  
13   pointing device for speeches and otherwise, the light emitting source 90 is predisposed with  
14   a clip 98. To accommodate the clip 98, the cylindrical column 89 is provided with a slot 100  
15   in a slip ring 102 located at the adjacent end of the cylindrical column 89. Alternatively, is it  
16   contemplated that any light emitting source 90 currently available to the public may be utilized  
17   provided the light emitting source 90 functions as described herein. As a further alternative,  
18   the light emitting source 90 may be an incandescent light source, a light emitting diode light  
19   source, or any other type of light source currently available and known to the public provided  
20   that it functions in the manner described herein.

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1           The housing 82 secures the light emitting source 90 in a fixed position on the vehicle.

2   In the preferred embodiment, the light emitting source 90 is situated parallel to the vehicle in

3   relation to the trailer 30. In the preferred embodiment, the light source cover 84 traverses

4   from a closed position, as illustrated in Figure 4, in which the light source actuator 94 is

5   exposed to an open position, in which the light source actuator 94 is covered by the slip ring

6   102. The light source cover 84 also provides protection for the light emitting source 90 from

7   damage by any external forces. In the closed position, as the light source actuator 94 is not

8   activated, the light emitting source 90 does not emit the light beam 34. Upon the light source

9   cover 84 traversing from the closed position to the open position, the slip ring 102 slides

10   along the exterior of the light emitting source 90 until the slip ring 102 covers the light source

11   actuator 94. When the slip ring 102 covers the light source actuator 94, the slip ring 102

12   depresses the light source actuator 94 into the light emitting source 90 to activate the light

13   emitting source 90. When activated, the light beam 34 is generated and released from the

14   light emitting source 90 through the lens opening 96 and into the free rotating mirror

15   assembly 86. When the user desires to deactivate the light emitting source 90, the light

16   source cover 84 is traversed back to the closed position, thereby, uncovering the light source

17   actuator 94 and disengaging the slip ring 102 from the light source actuator 94. As the light

18   source actuator 94 is uncovered and disengaged with the slip ring 102, the light source

19   actuator 94 is released from the light emitting source 90.

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1           The free rotating mirror assembly 86 that receives the light beam 34 has a proximal  
2    end 106 and a distal end 108 separated by a clear tube 110. Encapsulated within the clear  
3    tube 110 is a gravity orientation balancer 112 and a mirror 114. A detached, exploded view  
4    of the free rotating mirror assembly 86 is more fully illustrated in Figure 5.

5           At the core of the free rotating mirror assembly 86 is the gravity orientation balancer  
6    112 and the mirror 114. The orientation balancer 112 is a half moon shaped member with a  
7    top surface 116. In the preferred embodiment, the top surface 116 is flat with a channel 120.  
8    The channel 120 has a channel width 122 and extends diagonally across the flat top surface  
9    116 at angle 124. In the preferred embodiment, the angle 124 is substantially 45 degrees.  
10   This causes the light beam 34 which is received into the free rotating mirror assembly 86 to  
11   be reflected by the mirror 114, discussed below, directly towards the trailer 30. The mirror  
12   114 has a mirror thickness 126 that is slightly less than the channel width 122 such that the  
13   mirror 114 is frictionally received and retained into the channel 120. The mirror 114 also has  
14   a mirror length 128 that extends along the channel 120 but does not exceed the length of the  
15   channel 120. The mirror 114 has a mirror centerpoint 130. In the preferred embodiment,  
16   the mirror 114 is received into the channel 120 such that the mirror centerpoint 130 is at the  
17   approximate location of the centerpoint 132 of the channel 120 which also corresponds to the  
18   centerpoint of the orientation balancer 112. As the mirror 114 and the orientation balancer  
19   112 share the same centerpoints, once the mirror 114 is received into the channel 120, the  
20   orientation balancer 112 will continue to maintain a balanced equilibrium in which the top

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1 surface 116 of the orientation balancer will be parallel to the ground. The balanced  
2 equilibrium of the free rotating mirror assembly 96 is discussed in further detail below.

3 Extending outwardly from each side of the orientation balancer 112 are identical arms  
4 134. Each arm 134 is half moon shaped and has an arm top surface 136 and a bottom surface  
5 118 with an arc 138. The top surface 136 of the arm 134 and the top surface 116 of the  
6 orientation balancer 112, in the preferred embodiment, forms one complete flat surface.

7 Located adjacent to the orientation balancer 112 are identical wheels 140. Each wheel  
8 140 has an outside tube 142, a center tube 144, and a wheel opening 145. The outside tube  
9 142 and the center tube 144 are separated by ball bearings 146 and ball bearing dividers 148.

10 To assemble the free rotating mirror assembly 86 as illustrated in Figure 6, the mirror  
11 114 is first inserted and frictionally received into the channel 120 of the orientation balancer  
12 112. Each arm 134 of the orientation balancer 112 is then received into the wheel opening  
13 145 of the wheels 140 with the arc 138 of the bottom surface 118 being secured to the inside  
14 of the center tube 144. The bottom surface 118 is preferably secured to the center tube 144  
15 by glue. Alternatively, the bottom surface 118 may be secured to the center tube 144 by any  
16 known means or method publicly available provided that the orientation balancer 112 remains  
17 in a fixed position relative to the center tube 144. The mirror 114, the orientation balancer  
18 112, and the wheels 140 are received into and encapsulated by the clear tube 110. At the  
19 distal end 108 of the free rotating mirror assembly 86, an end cap 150 closes the components  
20 within the clear tube 110. The end cap 150 consists of a connection member 152, a ring 154,

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1 and a stopper 156. The connection member 152 and the stopper 156 are each provided with  
2 ledges 158 that are frictionally received by the wheel 140 and ring 154, respectively, for  
3 securing the connection member 152 to both the wheel 140 and the stopper 156, thereby,  
4 forming the end cap 150. An identical connection member 160 is likewise used to secure the  
5 proximal end 106 of the free rotating mirror assembly 86 to the light source cover 84 or  
6 housing 82.

7 As the vehicle backs up towards the trailer, the vehicle will most likely encounter  
8 aberrant or uneven terrain. The electronic back-up alignment apparatus 20 and, more  
9 specifically, the free rotating mirror assembly 86 automatically corrects for such terrain and  
10 continually maintains the guideline 44 in a horizontal plane in relation to the ground. In this  
11 manner, the directional guideline 44 will always be directed towards the trailer 30 for  
12 producing the virtual tow point 38.

13 For example, while in the perfect alignment, when the vehicle encounters a dip in the  
14 terrain, the truck bed 24 will likewise accommodate the dip and thereby attempt to force the  
15 electronic back-up alignment apparatus 20, the directional guideline 44, and virtual tow point  
16 38 to point in a direction towards the ground and, consequently, out of sight of the user and  
17 not towards the trailer. The free rotating mirror assembly 86 counters this to keep the  
18 directional guideline 44 in a horizontal plane in relation to the ground and provide a useful  
19 virtual tow point 38. As the dip occurs, the orientation balancer 112 and the center tube 144  
20 within the wheel 140 begin to correspondingly rotate in the opposite direction of the direction

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1 of the vehicle and truck bed 24. As the orientation balancer 112 is fixedly secured to the  
2 center tube 144 by arms 134, the weight of the gravity orientation balancer 112 counters the  
3 rotation of the electronic back-up alignment apparatus 20 (i.e., which is fixedly secured to the  
4 vehicle by the housing 82) and forces the ball bearings 146 in the wheels 140 in the opposite  
5 direction of the electronic back-up alignment apparatus 20 to keep the orientation balancer  
6 112 and the mirror 114 in a position parallel to the ground and directly facing the trailer 30.  
7 Despite any and all fluctuations to the vehicle, the electronic back-up alignment apparatus 20  
8 continually adapts to the aberrant or uneven terrain to produce a directional guideline 44 in  
9 a horizontal plane and a virtual tow point 38 for aligning the vehicle to the trailer 30 and  
10 maintaining the perfect alignment.

11 In the above analysis, the ground is assumed to be relatively flat which the exception  
12 of the aberrant or uneven terrain encountered between the vehicle and the trailer. If, however,  
13 the ground is at a high angle to the horizontal plane such as that produced by a hill, the  
14 vehicle will either be in a position higher than the trailer (i.e., if the vehicle is backing down  
15 the hill towards the trailer) or a position lower than the trailer (i.e., if the vehicle is backing  
16 up the hill towards the trailer). In either of these positions, as the free rotating mirror  
17 assembly 86 maintains the guideline 44 in a horizontal plane, the virtual tow point 38 may not  
18 be visible on the trailer 30 until the vehicle approaches to the trailer 30 such that the trailer  
19 30 is within the horizontal plane of the electronic back-up alignment apparatus 20. In these  
20 situations, the distance between the vehicle and the trailer 30 where the trailer 30 is within the



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1 horizontal plane is dependent upon the height of the trailer 30 or boat 56.

2 Magnets 104 (Figure 1) located in the base of the housing 82 are provided to secure  
3 the electronic back-up alignment apparatus 20 to the truck bed 24 or at any other desired  
4 location on the vehicle for use. Alternatively, it is contemplated that any known means or  
5 method may be utilized to secure the electronic back-up alignment apparatus 20 to the  
6 vehicle.

7 The electronic back-up alignment apparatus 20 described herein may further be  
8 enhanced with a device for measuring the distance between the vehicle and the trailer 30 such  
9 as a sonar or anti-collision system as illustrated in Figure 7. A transmitter 162 sends a signal  
10 in the direction of an object surface or the trailer 30. The transmitted signal is derived from  
11 a clock driven pulse generator 163 and is synchronous with the leading edge of the clock  
12 signal 165. The transmitted signal is reflected from the object surface or the trailer 30 and  
13 transformed into a reflected signal which is detected by a suitable receiver 164. The reflected  
14 signal is converted into a signal pulse to reset a toggle mode flip-flop circuit 166. The distance  
15 between the vehicle and the trailer 30 is derived from the travel time to and from the trailer  
16 30 and is represented by a pulse-width modulated signal 168. As depicted, the pulse-width  
17 modulated signal 168 has a shorter duty cycle for close distances and a longer duty cycle for  
18 longer distances. This signal is then used to turn the light emitting source 90 on and off and  
19 indicating a closer or farther distance by the apparent intensity of the light beam.  
20 Alternatively, it is contemplated that the pulse-width modulated signal can be filtered to

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1 obtain a direct current average voltage for varying the frequency of a voltage controlled  
2 oscillator 170. In this manner, the distance information can be provided as a function of the  
3 light source pulse rate.

4 As an alternative enhancement, the electronic back-up alignment apparatus 20  
5 described herein may include a device for measuring the distance between the vehicle and the  
6 trailer 30, in the same manner as the sonar or anti-collision, except using an ultrasonic system  
7 as illustrated in Figure 8. The ultrasonic system is provided with pulse counting indicators  
8 172. Preferably, the counting indicators 172 value activates the light emitting diodes  
9 represented by numbers 1 through 6. The number 1 represents to the user that the vehicle is  
10 approaching the trailer 30. As the vehicle continues to get closer to the trailer 30, the next  
11 light emitting diode number 2 is activated. When the vehicle continues to get even closer, the  
12 light emitting diode number 3 is activated. This continues with light emitting diode numbers  
13 4 and 5 until the vehicle finally reaches the trailer 30 as light emitting diode number 6 is  
14 activated. In this manner, the light emitting diode counting indicators 172 provide the user  
15 with a visual indication of how close the vehicle is to the trailer 30. The light emitting diode  
16 numbers are affixed to the electronic back-up alignment apparatus 20 for viewing by the user  
17 as depicted in Figure 9. A battery 174 powers the counting indicators 172 by a light emitting  
18 diode circuit. The electronic circuit board of the ultrasonic system and activates the light  
19 emitting diode numbers is illustrated in Figure 10.

**U.S. PATENT APPLICATION**

**INVENTION : Virtual Electronic Back-up Alignment Apparatus**

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1           Thus, there has been provided an electronic back-up alignment apparatus that utilizes  
2   a light emitting source coacting with a free rotating mirror assembly for providing a  
3   directional beam which is visible by the driver for aligning the hitch of a vehicle in relation to  
4   the tow hitch of a trailer. While the invention has been described in conjunction with a specific  
5   embodiment, it is evident that many alternatives, modifications and variations will be apparent  
6   to those skilled in the art in light of the foregoing description. Accordingly, it is intended to  
7   embrace all such alternatives, modifications and variations as fall within the spirit and scope  
8   of the appended claims.